

REMARKS

Reconsideration of the above identified application in view of the preceding amendments and following remarks is respectfully requested.

Claims 1-40 were pending in this application. By this Amendment, Applicant has amended Claims 2, 14, 22, 23, 24, 30, 32, 33, 37, 39, and 40 and cancelled Claims 6 and 15-20. No Claims have been added. Accordingly, Claims 1-5, 7-14 and 21-40 are now pending in this application. It is respectfully submitted that no new matter has been introduced by these amendments, as support therefor is found throughout the specification and drawings.

In response to the Election/Restriction Requirement set forth in the Office Action, Applicant elects to prosecute the claims of Species I (Claims 3-5, 7-14 and 21-40) along with the claims identified as generic by the Examiner, namely Claims 1 and 2. This election is made without prejudice to Applicant's right to pursue any non-elected claims in a continuation or divisional application, and/or to amend the non-elected claims to obviate the basis for restriction. Additionally, in the event Claims 1 and 2 are held allowable, Applicant requests that the original Claims depending therefrom be rejoined.


Applicant has amended the specification to correct grammatical informalities. Applicant respectfully submits that no new matter has been introduced by these amendments. In accordance with 37 C.F.R. § 1.121, the substitute specification is appended hereto in a version which indicates the amendments.

Applicant has amended Claims 2, 14, 22, 23, 24, 30, 32, 33, 37, 39, and 40 to correct grammatical informalities. In accordance with the 37 C.F.R. §1.121, the amended claims are appended hereto in a version which indicates the amendments.

No fee is believed associated with this submission. However, if any fee is required or otherwise if necessary to cover any deficiency in fees already paid, authorization is hereby given to charge our Deposit Account No. 50-1631

Respectfully submitted,

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George N. Chaclas, Reg. No. 46,608
Cummings & Lockwood
Attorney for Applicant
Grante Square
700 State Street
P.O. Box 1960
New Haven, CT 06509
Tel: (860) 275-7045

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

2. (Amended) The band saw blade of claim 1 wherein:

each of the set teeth comprise a relief surface and a cutting surface, the relief surface extending from one side of the tip in a direction opposite that of the movement of the band saw blade and terminating at one end of an intermediate surface, and the cutting surface extending from another side of the tip; and

the shelf comprises a shelf surface extending from the cutting surface and terminating at another end of the intermediate surface.

14. (Amended) The band saw blade of claim 12 wherein:

the second portion comprises about one third of the length of the shelf surface; and

the angle (A2) is approximately 15°.

22. (Amended) The band saw blade of claim 21 wherein the relief portion also ~~comprises~~ defines a tangential angle (TA) within the range of approximately 3° to approximately 6° ~~to~~ with respect to the side of the blade body-210.

23. (Amended) The band saw blade of claim 3 wherein:

a plurality of set teeth each comprise a second shelf;

each second shelf comprises a second shelf surface, and each second shelf defines a dimension (S2) extending between the tip of a ~~particular~~ the respective tooth and the second shelf.

24. (Amended) The band saw blade of claim 23 wherein $S2 = (B + S1) \div 2$ and S1 is within the range of between approximately .13 inch and approximately .16 inch.

30. (Amended) The band saw blade of claim 28 wherein:

each of the set teeth comprise a relief surface and a cutting surface, the relief surface extending from one side of the tip in a direction opposite that of the movement of the band saw blade and terminating at one end of an intermediate surface, and the cutting surface extending from another side of the tip; and

the shelf comprises a shelf surface extending from the cutting surface and terminating at another end of the intermediate surface.

32. (Amended) The band saw blade of claim 31 wherein:

a plurality of set teeth each comprise a second shelf;

each second shelf comprises a second shelf surface, and each second shelf defines a dimension (S2) extending between the tip of ~~a particular~~ the respective tooth and the second shelf.

33. (Amended) The band saw blade of claim 32 wherein $S2 = (B + S1)/2$ and S1 is within the range of between approximately .13 inch and approximately .16 inch.

37. (Amended) The band saw blade of claim 35 wherein:

each of the set teeth comprise a relief surface and a cutting surface, the relief surface extending from one side of the tip in a direction opposite that of the movement of the band saw blade and terminating at one end of an intermediate surface, and the cutting surface extending from another side of the tip; and

the shelf comprises a shelf surface extending from the cutting surface and terminating at another end of the intermediate surface.

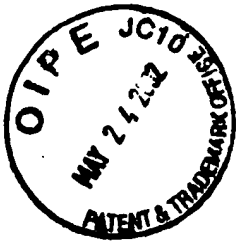
39. (Amended) The band saw blade of claim 38 wherein:

a plurality of set teeth each comprise a second shelf;

each second shelf comprises a second shelf surface, and each second shelf defines a dimension (S2) extending between the tip of ~~a particular~~ the respective tooth and the second shelf.

40. (Amended) The band saw blade of claim 39 wherein $S2 = (B + S1) \div 2$ and S1 is within the range of between approximately .13 inch and approximately .16 inch.

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SUBSTITUTE SPECIFICATION
WITH MARKINGS TO SHOW CHANGES MADE

Wood Cutting Band Saw Blade

Field of the Invention

The present invention relates generally to saw blades and, more particularly, to wood cutting band saw blades having a tooth form configured to reduce saw dust passing to the kerf walls and to the side walls of the band saw blade.

Background Information

It is desirable to minimize the amount of sawdust remaining on the kerf walls when cutting work pieces. For example, excessive saw dust remaining on wood products, such as pallets, will tend to collect in the eyes and/or breathing passages of workers handling the pallets. In addition, dust can be particularly problematic when cutting frozen wood, such as logs. In particular, the fast-moving blade creates friction that, in turn, heats the wood and allows the wood to release moisture. The moisture collects on the kerf walls and sides of the band saw blade, and binds the sawdust thereon into a glue-like mixture. Then, the glue-like mixture freezes when the blade exits the work piece, resulting in a frozen, hardened layer of saw dust on the side walls of the blade. The frozen layer of sawdust can cause unwanted vibrations in the saw blade, and if sufficiently thick, can cause the blade to fracture.

U.S. Patent No. 820,969 to Grelck ("Grelck") shows a wood-cutting saw blade wherein the front of each tooth is provided with one or more projections which act as "sawdust-removers" to remove the sawdust as it is produced. More specifically, FIG. 1 shows a saw blade with each tooth "b" provided on its front or cutting edge and below its point with a projection "c". In FIG. 4, each tooth is provided with two such projections "c" and "d" spaced relative to each other. Grelck teaches that only the very end of the point of the tooth is set, and thus the bend plane of each tooth is spaced above the projections "c" and "d". Accordingly, saw dust which is created along the sides of the points that have been set is not captured by the projections "c" and "d" as they are below the bend plane. Instead, saw dust passes by either side of the projections in the direction of the kerf walls thereby building up and causing the above-described problems.

Accordingly, it is an object of the present invention to provide a saw blade which better reduces the quantity of saw dust collecting on the kerf walls.

It is also an object to overcome one or more of the above-described drawbacks and disadvantages of the prior art.

Summary of the Invention

The present invention is directed to a wood cutting band saw blade that when cutting wood produces saw dust and forms a kerf. The band saw blade comprises a cutting edge defined by a plurality of teeth spaced relative to each other, and a back edge located on an opposite side of the band saw blade relative to the cutting edge. The plurality of teeth comprise a plurality of set teeth each having a tip, each defining a bend plane, and each comprising a shelf located at least partially between the tip and the bend plane for reducing saw dust passing to the kerf and accumulating on the band saw blade.

Preferably, each of the set teeth defines at least one relief surface and a cutting surface, where the relief surface extends from one side of the tip in a direction opposite that of the

movement of the saw blade and terminating at one end of an intermediate surface, and the cutting surface extends from another side of the tip. Preferably, the shelf includes a shelf surface extending from the cutting surface and terminating at another end of the intermediate surface.

Another aspect of the present invention is directed to a wood cutting band saw blade
5 having a lateral surface and generating dust during cutting of wood. The band saw blade comprises a base having a back edge and a cutting edge defined by a plurality of teeth spaced relative to each other and being located on an opposite side of the band saw blade relative to the back edge. The plurality of teeth comprise a plurality of set teeth, of which each set tooth ~~defining~~ defines a tip, a bend plane and a dust gap extending approximately between an outer lateral point of the tip and a
10 lateral surface of the base. The band saw blade further comprises means for reducing the quantity of dust passing through the dust gap.

A further aspect of the present invention is directed to a wood cutting band saw blade having a lateral surface and generating dust during cutting of wood. The band saw blade comprises a base having a back edge and a cutting edge defined by a plurality of teeth spaced relative to each
15 other and being located on an opposite side of the band saw blade relative to the back edge. The plurality of teeth comprise a plurality of set teeth, of which each set tooth ~~defining~~ defines a tip, a bend plane and a dust gap dimension extending approximately between an outer lateral point of the tip and a lateral surface of the base. The band saw blade further comprises means for reducing the dust gap dimension. In a preferred embodiment of the present invention, the means for reducing the
20 dust gap dimension includes at least one shelf formed between the bend plane and the tip of a set tooth. In another embodiment of the present invention, the means ~~of~~ for reducing the dust gap dimension further includes a relief portion extending from the tip of a set tooth at an acute angle to a transverse axis of the saw blade.

One advantage of the present invention is that the location of the shelf or like means for reducing the quantity of dust passing through the dust gap minimizes the collection of dust on both the kerf walls and sides of the saw blade.

Other advantages of the present invention will become readily apparent in view of the following detailed description of preferred embodiments and accompanying drawings.

Brief Description of the Drawings

FIG. 1 is a side elevational view of a portion of a wood cutting band saw blade showing a pair of teeth comprising a shelf located between a tip and a bend plane in accordance with an embodiment of the present invention.

FIG. 2 is an enlarged cross-sectional view taken along line 2-2 of FIG. 1 showing a pair of teeth adjacent to a kerf wall.

FIG. 3 is an enlarged cross-sectional view taken along line 3-3 of FIG. 1.

FIG. 4 is a side elevational view of a portion of a wood cutting band saw blade showing a single tooth having a generally linear shelf surface in accordance with another embodiment of the present invention.

FIG. 5 is a somewhat schematic, cross-sectional view of another embodiment of the wood cutting band saw blade of the present invention wherein each set tooth includes a shelf and a relief portion to further reduce or minimize the dust gap between the blade and kerf walls.

FIG. 6 is a somewhat schematic, partial top plan view of the band saw blade of FIG.

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FIG. 7 is a side elevational view of a portion of a wood cutting band saw blade showing a single tooth having a two shelves in accordance with another embodiment of the present invention.

Detailed Description of the Preferred Embodiments

A wood cutting band saw blade in accordance with an embodiment of the present invention is illustrated generally at 10 in FIG. 1. The band saw blade 10 defines a cutting direction indicated by the arrow a, and comprises a band 12 having cutting edge 14 and a base 15 including a back edge 16. The band saw blade 10 defines a longitudinal axis "L" and a transverse axis "T". It will be appreciated by those of ordinary skill in the relevant art that the cutting edge 14 of the band saw blade 10 comprises a plurality of teeth 17, 17', 17''(FIG. 2) etc., disposed along the cutting edge. It will also be appreciated that all or a subset of the teeth 17, 17', 17'', etc. may be angled or set along a bend plane 18 as better seen in FIG. 2.

Referring now to FIG. 2, a plurality of the teeth 17, 17', etc. are each set at an angle A', A'', etc. relative to axis A. In the preferred embodiments of the present invention, angle A', A'', etc. as preferably within a range of approximately 75-89°, and most preferably approximately 84° (or approximately 1° to approximately 15° with respect to transverse axis T). It will be understood that Angles A', A'', etc. may also vary from tooth to tooth in a particular pattern. Also, each of the teeth 17, 17'', may be set in a manner such that they extend in directions which alternate from one side of transverse axis T of the band saw blade 10 to the other side, as illustrated in FIG. 2. In another example, the pattern may comprise both set teeth and unset or straight teeth. In a preferred embodiment, the pattern may include five teeth comprising a first unset tooth and four set teeth, the latter four of which alternate from one side of the transverse axis T to the other side. Other patterns also may be employed in accordance with the present invention. For example, U.S. Patent ~~Application Serial No. 09/435,108~~ No. 6,276,248 entitled "Band Saw Blade Having Reduced Noise and Uniform Tooth Loading Characteristics", (~~Atty. Docket No. 010211-0033~~) assigned to the assignee hereof, and hereby incorporated herein by reference as part of the present disclosure,

describes several tooth patterns that may include variously setting primary, secondary and tertiary teeth in such a manner as to minimize noise and vibration of the band saw blade.

Referring again to FIGS. 1 and 2, the teeth 17, 17' each comprise a tip 20, 20', a relief surface 22, 22', and a cutting surface 24, 24', and each tooth is separated from the next by an intermediate surface comprising a curvilinear base surface 26 defining a gullet 28. The relief surface 22, 22' and cutting surface 24, 24' each extend from the tip 20, 20', and preferably connect together with the curvilinear base surface 26 defining the gullet 28. It will be understood that the curvilinear base surface 26 may be configured in a particular shape that assists in discharging dust and chips created during cutting. Such a configuration is described, for example, in U.S. Patent Application Serial No. 09/015,122, (~~Atty. Docket No. 010211-0007~~) No. 6,167,792, entitled "Improved Tooth Form For A Saw Blade", ~~filed January 29, 1998~~ and assigned to the Assignee hereof, the entire contents of which is hereby incorporated herein by reference as part of the present disclosure.

In accordance with a feature of the present invention, each set tooth 17, 17', etc. defines a shelf 30, 30' extending from the cutting surface 24, 24' and comprising a shelf surface 34, 34' and a shelf tip 36, 36'. The shelf 30, 30' is configured to function, as described in more detail below, to collect saw dust, e.g. various sized wood chips and other particulate matter generated during cutting of a kerf including a kerf wall 38 in a work piece 39, as shown in FIG. 2, and to remove the collected dust away from the kerf wall 38. It will be recognized that the shelf tip 36, 36' may be of any suitable configuration including, e.g., a rounded configuration (not shown).

As used herein, the term shelf refers to any suitable structure which may capture and/or remove sawdust during cutting of a work piece such as, for example, a ledge-like structure ~~jutting out~~ extending outwardly from a cliff-like structure ~~is particularly applicable to as illustrated in~~ the disclosed embodiment.

It will be understood by one of ordinary skill in the pertinent art that the location and dimensions of the shelf 30, 30' affects the functionality of the shelf in removing dust. For simplicity, the following will use tooth 17' for an example in describing the location of the shelf 30'; however, it will be understood that this description may be equally applicable to all teeth disposed on the band saw blade 10. As shown in FIG. 2, the distance S1 between the tip 20' and shelf tip 36' is defined as "S1," and the distance between the tip 20' and the bend plane 18 is defined as "B". Also, the distance between the tip 20' and the curvilinear base surface 26 is defined as "D". If S1 is set to approximately equal to or below B, then the shelf 30' will not be in a proper location to "catch" and remove the dust cut from the kerf wall 38. Specifically, a dust gap "DG" is defined between a lateral point 40' of the tooth 17' (which also establishes the kerf wall 38) and a side surface 42 at the base of the band saw blade 10. Effectively, the shelf 30' reduces the size of the dust gap or creates an effective dust gap "EDG" that is substantially less than DG.

It has been found that S1 preferably ranges from between approximately 0.060 inch and approximately 0.120 inch, and is most preferably approximately 0.090 inch, where B is approximately 0.200 inch and D is approximately 0.300 inch.

In order to quantify a percent reduction of the dust gap size, the ratio of S1/B is utilized. The present inventor has determined that the ratio of S1/B preferably ranges between approximately 0.25 and approximately 0.75, more preferably ranges between approximately 0.30 and approximately 0.60, and most preferably is approximately 0.45. Accordingly, a shelf depth of approximately $\frac{1}{3}$ D (or approximately $\frac{1}{2}$ the depth of the bend plane) is sufficient to prevent choking and provide a desirable effective dust gap. It will be understood that these dimensional parameters apply to straight or unset teeth as well as to set teeth.

It also will be appreciated that the width of the effective dust gap can not only be manipulated by adjusting the depth (dimension S1) of the shelf, but also by adjusting the set angle A'

of the tooth 17'. For example, increasing the set angle A' relative to the transverse axis T, as illustrated in FIG. 2, will necessarily reduce the width of the effective dust gap.

The configuration of the shelf 30' also influences the ability of the shelf to remove dust. For example, it will be recognized that the available space created by the length of the shelf surface 34' must be sufficient to prevent dust from "choking" or over-filling the shelf. With reference to FIG. 1, it has been found that the length "L1" of the shelf surface 34' is preferably between approximately 0.060 inch and approximately 0.100 inch, and most preferably is approximately 0.08 inch. The length L1 may be made between the projected intersection of the cutting surface 24' and shelf surface 34' and an outer edge of the shelf tip 36'.

The shelf surface 34, 34' also may be angled to optimize dust capture and prevent, e.g., choking as discussed above. In particular, by angling the shelf with respect to the back edge 16 of the blade, the quantity of sawdust captured and the re-direction of the chip flow, e.g., to the gullet 28 for sweeping the chips out of the kerf is increased. For example, while shelf surface 34, 34' may comprise a first portion 34a, 34'a that may be generally parallel to the back edge 16 of the band saw blade 10, a second portion 34b, 34'b is provided that is disposed at an angle " $A1$ " relative to the back edge. Angle $A1$ is preferably between approximately 10° and approximately 20° , and is most preferably approximately 15° in the direction of the back edge. However, it will be understood that less preferably the shelf surface may be angled in a direction away from the back edge (not shown). Optionally, the first portion 34a, 34'a may be angled relative to the back edge 16 at between approximately 4° and approximately 10° , and most preferably approximately 7° (not shown).

Another embodiment of the band saw blade of the present invention is shown generally at 110 in ~~Figure~~ FIG. 4. The band saw blade 110 is similar in many respects to the band saw blade 10 described above, and therefore like reference numerals preceded by the number 1 are used to indicate like elements.

In this embodiment, shelf surface 134 of the band saw blade 110 defines a generally planar configuration over substantially the entire shelf length, and a shelf angle A2 relative to the back edge 16 of between approximately 4° and approximately 10°, and most preferably approximately 7°.

5 Tests conducted cutting frozen cherry at a band speed of approximately 5500 feet per minute (FPM) and a board speed of approximately 65 FPM, using a band saw blade of the present invention being 1.348 inch high, by 0.042 inch thick and having 1 tooth per inch (TPI), was found to have a 70-90% weight percent reduction in residual saw dust on the finished boards as compared to cutting with a conventional band saw blade.

10 Referring now to FIGS. 1 and 3, the band saw blade 10 may also comprise a bump 42 that may function to urge chips received from a tooth 17' to be redirected toward the cutting edge 14 and out of the kerf. The bump preferably includes a height H that ranges from approximately 0.04 inch through approximately 0.06 inch, and a lateral width W which ranges from between approximately 0.005 inch to approximately 0.015 inch as measured from a respective side of the
15 band saw blade 10. The bump 42 is preferably formed by swaging. It will be appreciated, that swaging the bump (and by not locating the bump at the traditional location at the base of the rake face) substantially reduces the chances of the formation of harmful stress risers in the band saw blade 10.

Turning now to FIGS. 5 and 6, another embodiment of a band saw blade in
20 accordance with the present invention is shown generally at 210. The band saw blade 210 is similar in many respects to the band saw blade 10 described above, and therefore like reference numerals preceded by the number 2 are used to indicate like elements. In this embodiment, each of the set teeth includes a shelf 230 and a relief portion to further reduce or minimize the dust gap between the blade 10 and the kerf walls (not shown).

The band saw blade 210 is generally similar to the band saw blade 10 of ~~Figures~~ FIGS. 1-3; however, each set tooth 217', 217", etc. further includes a relief portion 244', 244", respectively, formed on the upper corner of the tooth on the side facing the respective kerf wall 238. As illustrated in FIG. 5, the relief portions 244', 244" each define a relief angle "RA" (shown in FIG. 5) which is preferably within the range of between approximately 0° and approximately 2° with respect to a plane defined by the unset tooth 220. The relief portions 244', 244" function to locate the respective shelf 230 closer to the kerf wall 238 to thereby further reduce the dust gap DG to DG1 and, in turn, decrease the effective dust gap from EDG to EDG1. The relief portion may also define a tangential angle "TA" (shown in FIG. 6). In this way, the edge is relieved to reduce the effects of friction during cutting of a work piece (not shown). The angle TA is preferably within the range of between approximately 3° and approximately 6° with respect to a plane defined by the side of the blade body 210. It will be understood that the dimensions and interrelationship of S1 and B, as described above, applies to the current embodiment as well. A straight or unset tooth 217 is also provided in this embodiment which also includes a shelf 230 similar to that described above.

~~Figure~~ FIG. 7 illustrates a band saw blade 310 in accordance with another embodiment of the present invention. The band saw blade 310 is similar in many respects to the band saw blade 10 described above, and therefore like reference numerals preceded by the number 3 are used to indicate like elements. The tooth 317 may be similar to teeth 17, 17', 17" and 117 described above in conjunction with FIGS. 1-3 and 5, although, the tooth 317 further includes a second shelf 346. The second shelf 346 comprises a second shelf surface 348 and a second shelf tip 350, and functions to re-direct chips which have passed the first shelf 330. Each second shelf 346 has a dimension S2 which is defined as ~~a length~~ the distance measured between the tip 320 of a particular tooth 317 and the second shelf tip 350. The dimensions S1 and B may both be determined in the same manner as discussed above in conjunction with FIGS. 1 and 2. It has been found that S2

is preferably determined through the relationship of $S2=(B+S1) \div 2$. Accordingly, for the range of S1 given above, S2 preferably is within the range of between .13 inch and .16 inch, and is most preferably .145 inch. It has been found that the shelf length L2 (measured in a similar manner to L1) is preferably approximately 70% to approximately 90% of L1. Most preferably, the shelf length L2 is approximately 80% of L1.

In the operation of the band saw blade, the shelf operates to collect substantially all of the sawdust generated upon cutting the work piece and tends to force the collected dust upwardly and out of the kerf. As a result, very little dust is allowed to fall downwardly into the dust gap formed between the sides of the blade and kerf walls. Also, a substantial clearance is maintained between the base of the blade and the kerf walls, thereby significantly reducing friction between the blade and kerf walls and, in turn, minimizing vibrations and increasing blade life in comparison to prior art band saw blades.

As may be recognized by those of ordinary skill in the pertinent art based on the teachings herein, numerous changes and modifications may be made to the above-described and other embodiments of the present invention without departing from its scope as defined in the appended claims. For example, the shelf or similarly functioning means, may take various different configurations while still performing the function of reducing the passage of saw dust into the kerf. In addition, the blade need not define any unset teeth; rather all teeth may alternate from one side of the transverse axis of the blade to the other. Accordingly, this detailed description of preferred embodiments is to be taken in an illustrative as opposed to a limiting sense.

Abstract of the Disclosure

A wood cutting band saw blade that when cutting wood produces saw dust and forms a kerf. The band saw blade includes a cutting edge defined by a plurality of teeth spaced relative to each other and a back edge located on an opposite side of the band saw blade relative to the cutting edge. The plurality of teeth include a plurality of set teeth each having a tip, each defining a bend plane, and each including a shelf located at least partially between the tip and the bend plane for reducing saw dust passing to the kerf and accumulating on the band saw blade. Each of the set teeth may define a relief surface and a cutting surface, where the relief surface extends from one side of the tip in a direction opposite that of the movement of the band saw blade and the cutting surface extends from another side of the tip. The shelf includes a shelf surface extending from the cutting surface and may terminate in a shelf tip.

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